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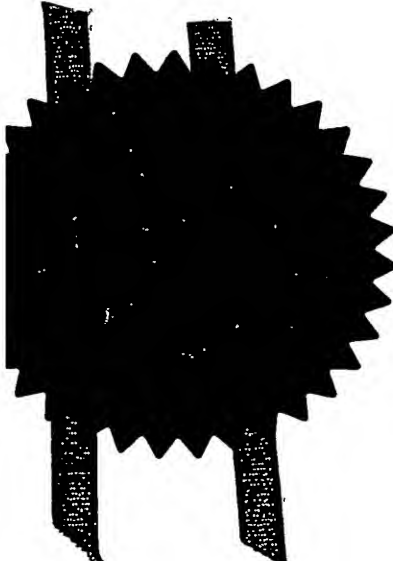
REC'D 14 SEP 2004	
WIPO	PCT

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*H. Behen*

Dated 27 August 2004

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- 6 AUG 2003

1/77

06AUG03 E828231-4 D01070  
P01/7700 0.00-0318417.3

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# Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

1.	Your reference	P4006.A1/PDW	- 6 AUG 2003
2.	Patent application number (The Patent Office will fill in this part)	0318417.3	
3.	Full name, address and postcode of the or of each applicant (underline all surnames)	Willet International Limited 3 Cronin Road Weldon South Industrial Estate CORBY NN18 8AQ	
	Patents ADP number (if you know it)		
	If the applicant is a corporate body, give the country/state of its incorporation	UNITED KINGDOM	8258/2203
4.	Title of the invention	Method and Device	
5.	Name of your agent (if you have one)	DUMMETT COPP	
	"Address for service" in the United Kingdom to which all correspondence should be sent (including the postcode)	25 THE SQUARE MARTLESHAM HEATH IPSWICH IP5 3SL	
	Patents ADP number (if you know it)	6379001	
6.	If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and (if you know it) the or each application number	Country	Priority application number (if you know it) Date of filing (day / month / year)
7.	If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application	Number of earlier application	Date of filing (day / month / year)
8.	Is a statement of inventorship and of right to grant of a patent required in support of this request? (Answer 'Yes' if: a) any applicant named in part 3 is not an inventor, or b) there is an inventor who is not named as an applicant, or c) any named applicant is a corporate body. See note (d))	YES	

## Patents Form 1/77

9. Enter the number of sheets for any of the following items you are filing with this form.  
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Continuation sheets of this form

Description 5

Claim(s) 0

Abstract 0

Drawing(s) 2 + 2

10. If you are also filing any of the following, state how many against each item.

Priority documents

Translation of priority documents

Statement of inventorship and right to grant of a patent (*Patents Form 7/77*)

Request for preliminary examination and search (*Patents Form 9/77*)

Request for substantive examination (*Patents Form 10/77*)

Any other documents  
(please specify)

11. I/We request the grant of a patent on the basis of this application.

*Dummett Copp*

Signature

Date

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5<sup>th</sup> August 2003

12. Name and daytime telephone number of person to contact in the United Kingdom  
Pete Wilson  
01473 660600

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### Notes

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# METHOD AND DEVICE

The present invention relates to a method of and device for cooling printing devices, and in particular devices comprising one or more arrays of ink jet valves.

Printers are used, to give just one example, to print onto a print substrate such as products and packaging on assembly lines, carpets, fabrics, etc. Print heads comprising arrays of many print elements are arranged together to print across a defined region of the print substrate. If the printing is in colour then it is necessary to have print heads that can print in black, cyan, magenta and yellow.

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According to a first aspect of the present invention there is provided a method of cooling a print head comprising one or more print elements, the method comprising the step of using a temperature control medium to regulate the temperature of one or more of the print elements. Preferably the temperature control medium is also a print medium.

According to a second aspect of the present invention there is provided a print head comprising one or more print elements, temperature control medium storage means, the storage means being in fluid communication with the one or more print elements such that, in use, temperature control medium can circulate from the storage means to the one or more print elements and thence to the storage

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means. Preferably the print head further comprises temperature control means that, in use, heats or cools the temperature control medium held in the storage means. The print head may also comprise one or more sensors arranged  
5 to measure the temperature of one or more print elements and to control accordingly the temperature control means.

A preferred embodiment of the invention control will now be described by way of illustration only and with respect  
10 to the accompanying drawings, in which

Figure 1 shows a schematic depiction of a known print head; and

Figure 2 shows a schematic depiction of a print head  
15 according to the present invention.

Figure 1 shows a schematic depiction of print head 100 comprising control means 150 and rows 160a, 160b, 160c ... of printing elements. The rows of printing elements are  
20 physically located in a vertical array so that the valves can deposit a two-dimensional matrix on a print substrate. The print head further comprises ink reservoir 120 and ink conduit 130 such that ink can be supplied from the reservoir to the printing elements. Each element may be  
25 individually connected to the conduit or there may be a manifold associated with each of the rows of printing elements such that the conduit is connected to each row of printing elements.

30 Modern printing technology enables printing at very high

speeds, for example in excess of 1kHz (see, for example, WO03/033951, PCT/GB2003/000633 and GB 0316266.6) and for the electro-magnetic valves used, for example, in drop-on demand ink jet printers the drive circuits generate significant amounts of heat. When a number of print heads are closely arranged together, and especially when colour printing is used, it is difficult to provide adequate cooling to the print heads by blowing cool air over the print heads.

10

If the print heads overheat then this can have serious effects on the print quality as the electronic circuits may be damaged (or may fail) and the ink properties may be affected, for example the viscosity of the ink may be decreased such that it is no longer suitable for the printing application or the long-term stability of the pigments in the ink may be affected.

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Figure 2 shows a schematic depiction of a print head 200 according to the present invention. The print head comprises control means 250, rows 260a, 260b, 260c ... of printing elements located in a vertical array so that the valves can deposit a two-dimensional matrix on a print substrate, ink reservoir 220 and first ink conduit 230. The print head further comprises second ink conduit 235 and temperature control means, which is coupled to the ink reservoir.

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In operation, the ink is pumped from the ink reservoir to the rows of printing elements. Clearly, when a printing

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element is operated some ink will be expelled and the ink pumped from the reservoir will replace the ink used in printing. Furthermore, some of the ink will be returned to the ink reservoir via the second conduit, from where  
5 the ink may be re-circulated again. If the operation of the print head, and other adjacent or proximate print heads, causes the temperature of the print heads to increase then the temperature of the ink in the second conduit will be greater than that of the ink in the first  
10 conduit. The ink may thus be used as a cooling medium with the temperature control means cooling the ink held within the ink reservoir and then circulated via the first conduit. By suitable control of the temperature control means, and thus the temperature of the ink, the flow of  
15 cooled ink to the print elements and then back to the ink reservoir, via the first conduit and the second conduit, enables the temperature of the print elements to be regulated. The temperature of the print elements may be inferred by measuring the temperature of the ink as it  
20 enters the first conduit from the ink reservoir and as it returns to the ink reservoir from the second conduit.

In a preferred embodiment of the invention, the print head further comprises one or more temperature sensors 270a,  
25 270b, 270c, ... located on or near to the print elements (although Figure 2 shows one temperature sensor being attached to each of the circuit boards to which the print elements are attached it will be understood that print sensors may be attached to one or more of the circuit  
30 boards or one or more of the print elements). The data

from the temperature sensors is polled by the control means 250 and this data is used to manage the temperature control means.

- 5 It will be understood that any cooling mechanism may be used to cool the temperature of the ink reservoir as long it is able to provide adequate cooling to the reservoir. Examples of suitable technologies include, without limitation, heat-sinks and fans mounted on the reservoir,
- 10 thermo-electric coolers, heat exchangers integrated with the reservoir, pumping hot ink into a radiator which may be further cooled, etc.

- Further to the above it should also be understood that
- 15 there may be some scenarios in which it is necessary to heat the ink and in this case the temperature control means may further comprise heating means, for example electrical heating elements.

- 20 The invention is applicable to all manner of print heads that use ink and for which temperature regulation may be required, and not just drop-on demand ink-jet printers.



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100

150

160c

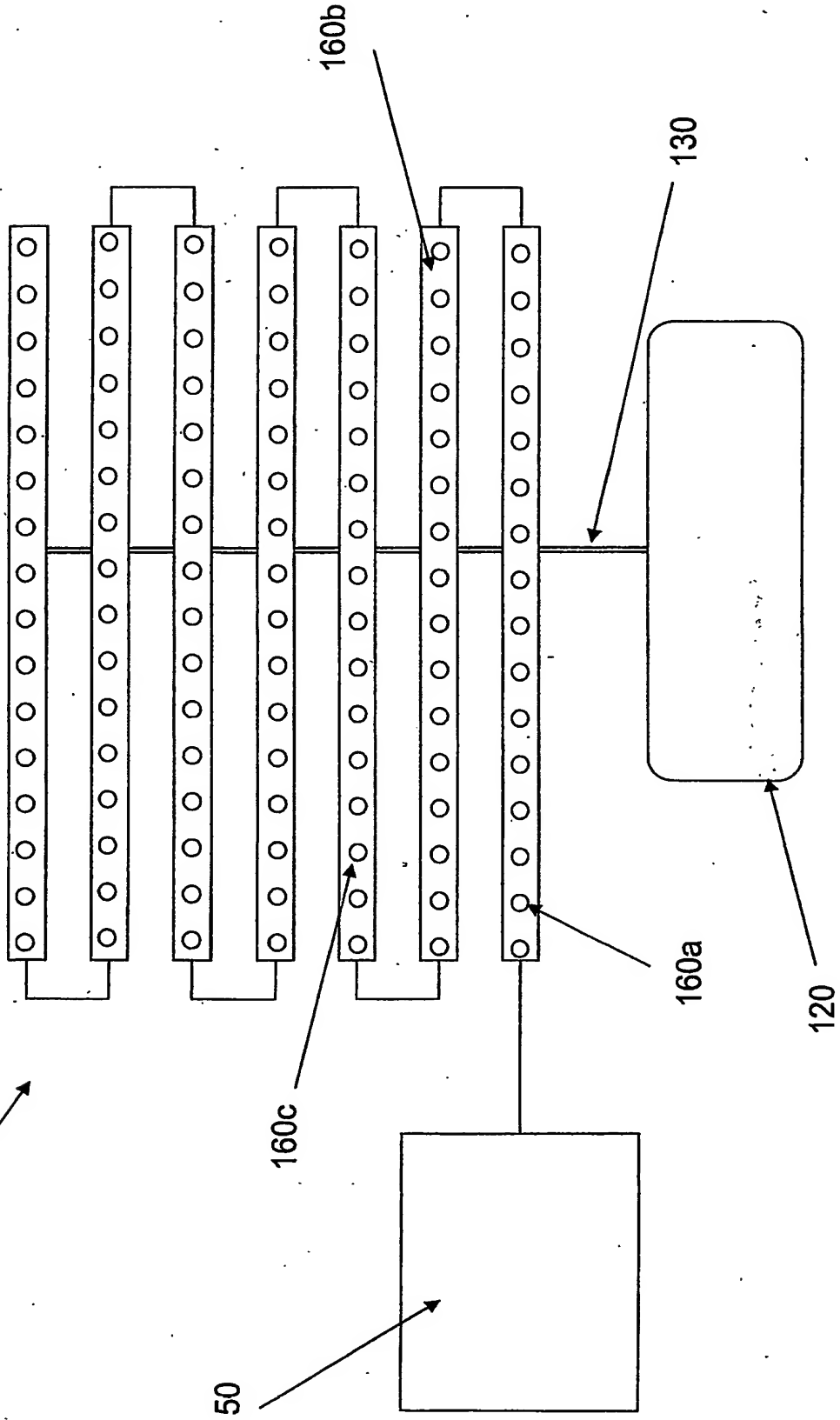
160b

160a

130

120

Figure 1



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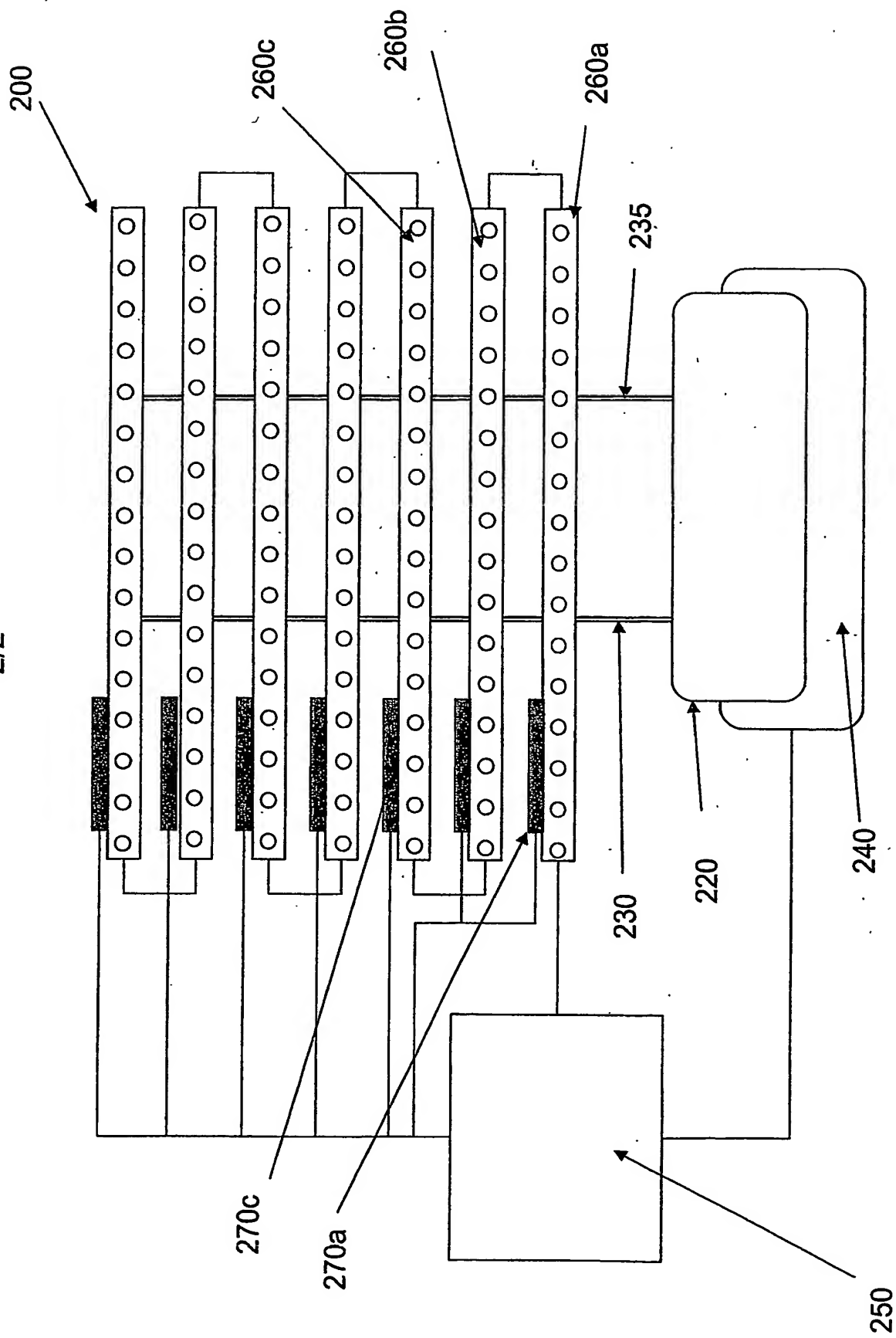


Figure 2